CLAIMS

What is claimed:

1. A semiconductor structure comprising:

a monocrystalline silicon substrate;

an amorphous oxide material overlying the monocrystalline silicon substrate;

a monocrystalline perovskite material overlying the amorphous oxide material;

a monocrystalline compound semiconductor material overlying the monocrystalline perovskite material; and

at least one piezoelectric material structure disposed on the monocrystalline compound semiconductor material, the piezoelectric material structure having a predetermined shape topography such that at least one portion of the piezoelectric material structure expands a different distance than at least one other portion of the piezoelectric material structure when a voltage is applied to the piezoelectric material structure, the different expansion distance resulting in displacement of an optical surface disposed on the piezoelectric material structure.

2. The semiconductor structure according to claim 1, further comprising:

a light emitting device providing a light beam directed at the optical surface of the piezoelectric material; and

wherein the displacement of the optical surface changes at least one positional aspect of the optical surface such that reflection of the light beam from the optical surface changes direction.

3. The semiconductor structure according to claim 1, wherein the optical surface is a mirrored surface.

4. The semiconductor structure according to claim 1, wherein the optical surface is a hologram.

5. The semiconductor structure according to claim 1, wherein the optical surface is a diffraction grating.

6. The semiconductor structure according to claim 1, wherein the optical surface is substantially planar.

7. The semiconductor structure according to claim 1, wherein the optical surface is a curved mirror having a focal point.

8. The semiconductor structure according to claim 7, wherein the displacement of the optical surface changes at least one positional aspect of the optical surface such that the focal point of the curved mirror is displaced.

9. The semiconductor structure according to claim 1, wherein the predetermined shape topography is a wedge.

10. The semiconductor structure according to claim 1, further comprising:
a plurality of piezoelectric material structures arranged in an array.

11. The semiconductor structure according to claim 10, wherein each of the plurality of piezoelectric material structures receives a corresponding controlling voltage input such that movement of each individual piezoelectric material structures or groupings of piezoelectric material structures in the array may be selectively operated.

12. The semiconductor structure according to claim 1, further comprising:
an array of electrodes disposed on an upper surface of the piezoelectric material structure, the array located between the upper surface and the optical surface, wherein voltages may be selectively applied to one or more portions of the piezoelectric material structure, thereby causing displacement of those one or more portions receiving application of a voltage.

13. The semiconductor structure according to claim 1, further comprising:
a second piezoelectric material structure disposed on the at least one piezoelectric material structure, the second piezoelectric material structure having a

prescribed topographic shape such that at least one portion of the second piezoelectric material structure expands a different distance than expansion of at least one other portion of the second piezoelectric material structure when a voltage is applied to the piezoelectric material structure, the different expansion distance resulting in angular movement of an optical surface disposed on the second piezoelectric material structure.

14. The semiconductor structure according to claim 1, wherein the at least one piezoelectric material structure is comprised of GaAs.

15. The semiconductor structure according to claim 1, wherein the at least one piezoelectric material structure is formed in the monocrystalline compound semiconductor material and comprised of the same semiconductive material as the compound semiconductor material.

16. The semiconductor structure according to claim 15, wherein the at least one piezoelectric material structure and the monocrystalline compound semiconductor material are comprised of GaAs.

17. A process for fabricating a semiconductor structure comprising:

providing a monocrystalline silicon substrate;

depositing a monocrystalline perovskite oxide film overlying the monocrystalline silicon substrate, the film having a thickness less than a thickness of the material that would result in strain-induced defects;

forming an amorphous oxide interface layer containing at least silicon and oxygen at an interface between the monocrystalline perovskite oxide film and the monocrystalline silicon substrate;

epitaxially forming a monocrystalline compound semiconductor layer overlying the monocrystalline perovskite oxide film.

disposing at least one piezoelectric material structure on the monocrystalline compound semiconductor layer, the piezoelectric material structure having a predetermined shape topography such that at least one portion of the piezoelectric material structure expands a different distance than at least one other portion of the piezoelectric material structure when a voltage is applied to the piezoelectric material structure, the different expansion distance resulting in displacement of an optical surface disposed on the piezoelectric material structure.

18. The process according to claim 17, further comprising:

providing a light emitting device that emits a light beam directed at the optical surface of the piezoelectric material; and

wherein the displacement of the optical surface changes at least one positional aspect of the optical surface such that reflection of the light beam from the optical surface changes direction.

19. The process according to claim 17, wherein the optical surface is a mirrored surface.

20. The process according to claim 17, wherein the optical surface is a hologram.

21. The process according to claim 17, wherein the optical surface is a diffraction grating.

22. The process according to claim 17, wherein the optical surface is substantially planar.

23. The process according to claim 1, wherein the optical surface is a curved mirror having a focal point.

24. The process according to claim 23, wherein the displacement of the optical surface changes at least one positional aspect of the optical surface such that the focal point of the curved mirror is displaced.

25. The process according to claim 1, wherein the predetermined shape topography is a wedge.

26. The process according to claim 1, further comprising:

arranging a plurality of piezoelectric material structures in an array.

27. The process according to claim 26, further comprising:

providing each of the plurality of piezoelectric material structures with a corresponding controlling voltage input such that movement of each individual piezoelectric material structures or groupings of piezoelectric material structures in the array may be selectively operated.

28. The process according to claim 17, further comprising:

disposing an array of electrodes on an upper surface of the piezoelectric material structure, the array located between the upper surface and the optical surface, wherein voltages may be selectively applied to one or more portions of the piezoelectric material structure, thereby causing displacement of those one or more portions receiving application of a voltage.

29. The process according to claim 17, further comprising:

disposing a second piezoelectric material structure on the at least one piezoelectric material structure, the second piezoelectric material structure having a prescribed topographic shape such that at least one portion of the second piezoelectric material structure expands a different distance than expansion of at least one other portion of the second piezoelectric material structure when a voltage is applied to the piezoelectric material structure, the different expansion distance resulting in angular movement of an optical surface disposed on the second piezoelectric material structure.

30. The process according to claim 17, wherein the at least one piezoelectric material structure is comprised of GaAs.

31. The process according to claim 17, wherein the at least one piezoelectric material structure is formed in the monocrystalline compound semiconductor layer and comprised of the same semiconductive material as the compound semiconductor layer.

32. The process according to claim 31, wherein the at least one piezoelectric material structure and the monocrystalline compound semiconductor material are comprised of GaAs.